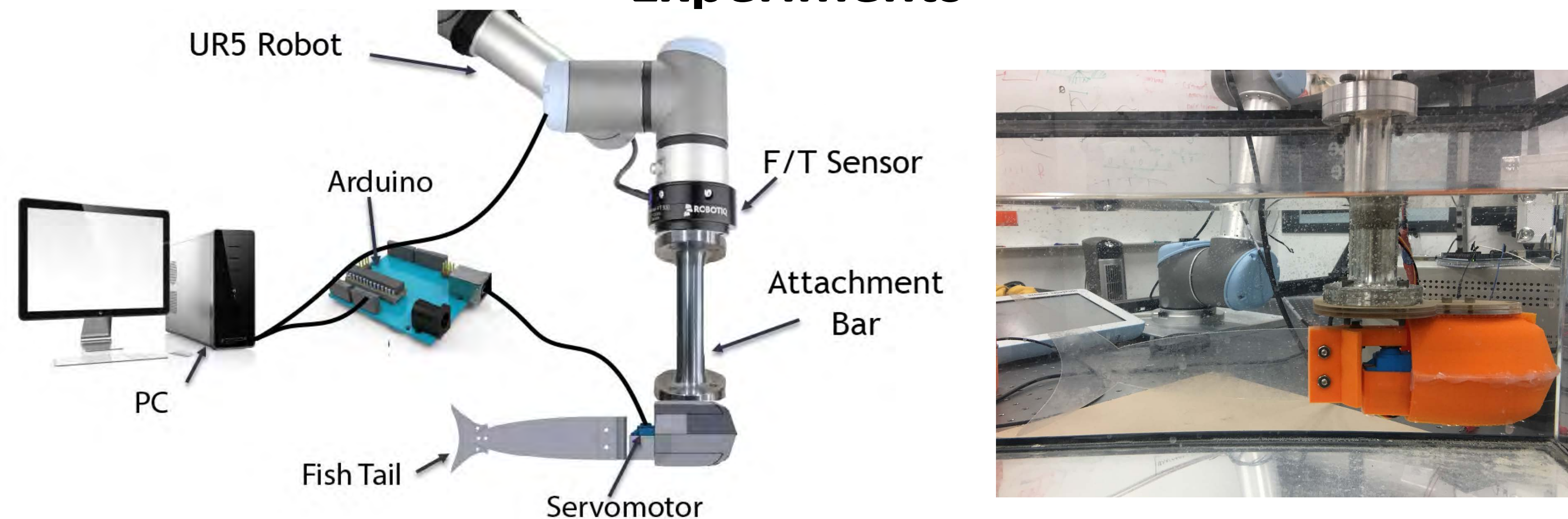


Problem

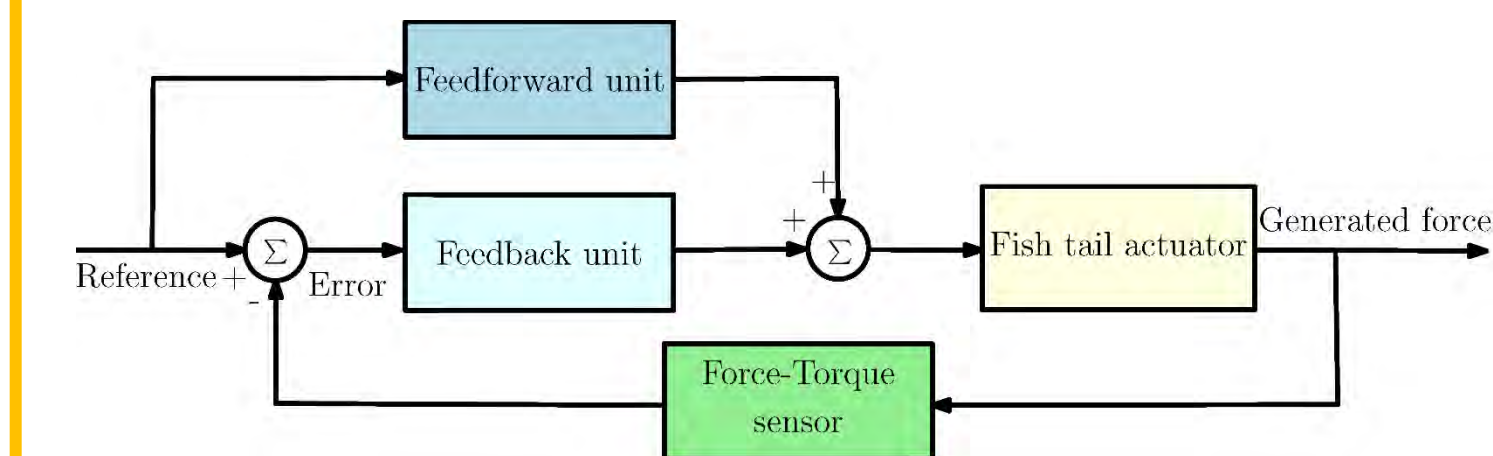
Vegetation and sediment buildup in irrigation canals reduces flow rates and reduces water volume in shallow channels. In this project, we focus on the locomotion of a fish-inspired robot which has been designed and built in order to maneuver inside the narrow lateral canals, and clean the canals by removing vegetation and sediment.

Experiments



Controller design

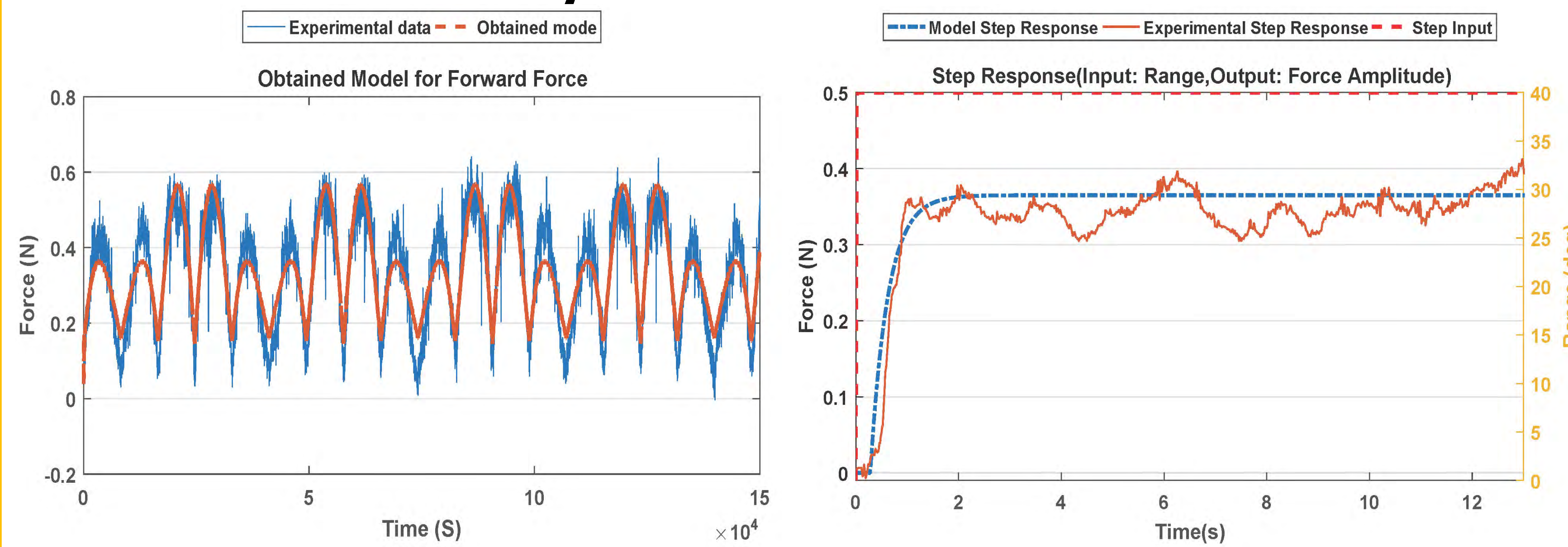
A feedback/forward controller is designed based on obtained models. The controller's model estimates the main force contribution while uncertainties are handled by the feedback unit.



Approach

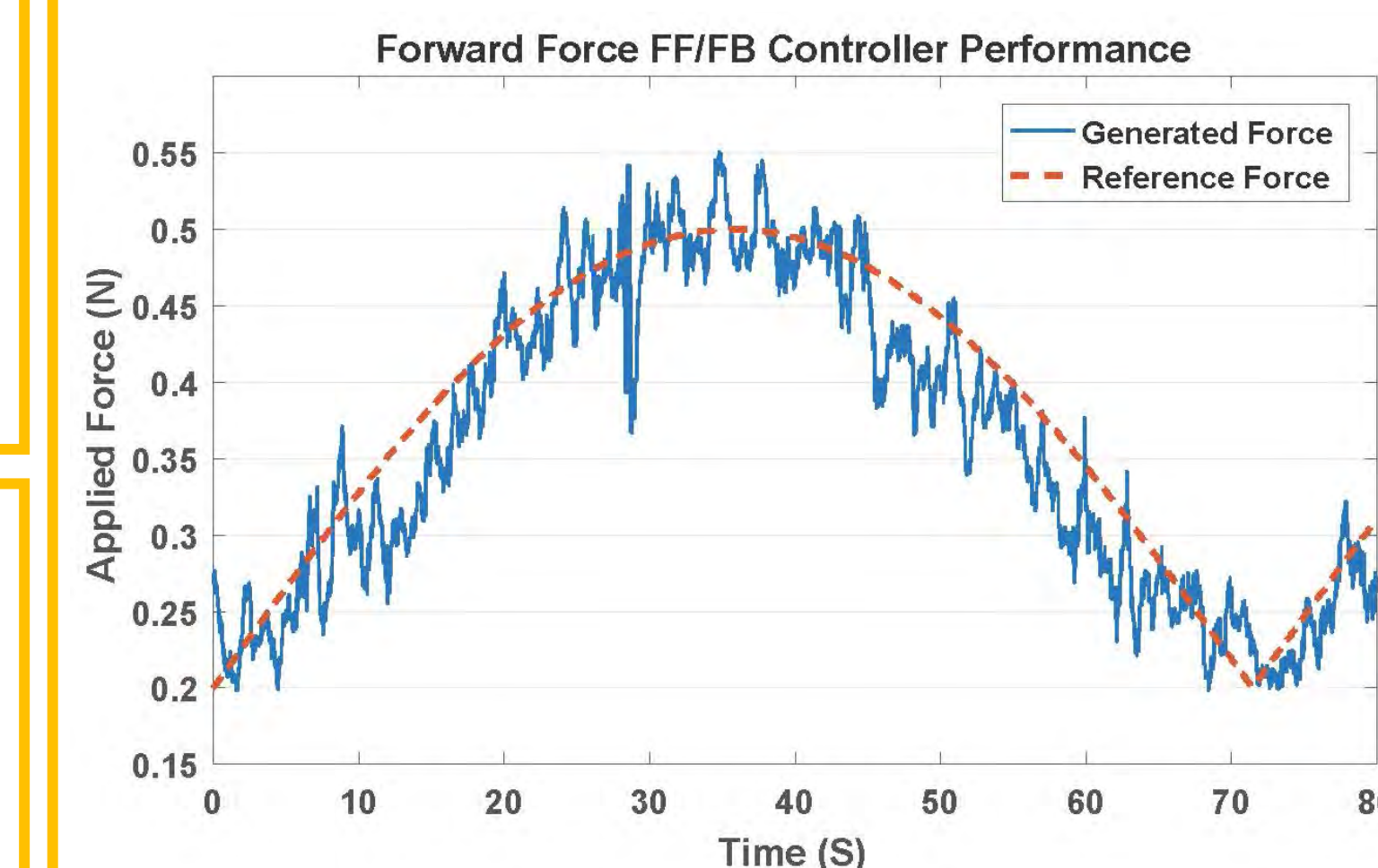
We have selected a fin propulsion mechanism inspired by fish locomotion. Based on existing literature, a fin has been designed that is capable to produce efficient propulsive force. This fin moves in the water via a motor which follows a sinusoidal rotation angle. The frequency and amplitude of the movements of the motor are the two inputs to the system which control the amount of force produced by fin propulsion. We identified the effect of inputs on generated force and obtained models that help us control the robot moving path in water.

System Identification



Verification

A PID controller is implemented in the feedback unit of the proposed feedback/forward controller. The force generated by the tail flapping is able to track the sinusoidal reference input.



Obtained Models

Transfer function for the force magnitude:

$$TF = \frac{0.00912e^{-0.28S}}{0.34S + 1}$$

Transfer function for the force direction:

$$TF = \frac{-0.866e^{-0.12S}}{0.13S + 1}$$